AIR MOVEMENT

UMODPC 612-605-01
TOBC 500-500-14

LOAD AND SECURE CARGO FOR AIR MOVEMENT

REFERENCE

DOD 4500.9-R DEFENSE TRANSPORTATION REGULATION PART III MOBILITY

FUNDAMENTALS OF RESTRAINT

- RESTRAINT CONSIDERATIONS
  - GRAVITY FORCE **“G”s**
  - GROSS WEIGHT OF CARGO (ITEM)
  - RATE OF CHANGE” **“SPEED”**

RESTRAINT CRITERIA

- **FORWARD 3.0 G's**
- **AFT 1.5 G's**
- **LATERAL (L/R) 1.5 G's**
- **VERTICAL 2.0 G's**

C-130, C-141, C-5, C-17

KC-10
AIRCRAFT
NOTE

Forward restraint for KC-10 is 9.0 G's without a barrier net.

Standard is 1.5 G's with barrier net installed.

All other directional restraint is the same as the other cargo aircraft.

RESTRAINT EQUIPMENT

- **CHAINS & DEVICES**
  - **MB-1 10,000 LB**
  - **MB-2 25,000 LB**
- **FITTINGS (C-141 ONLY)**
  - **A-7000 10,000 LB**
  - **A-2000 25,000 LB**
  - **COMBINATION 25,000 LB**
- **STRAPS**

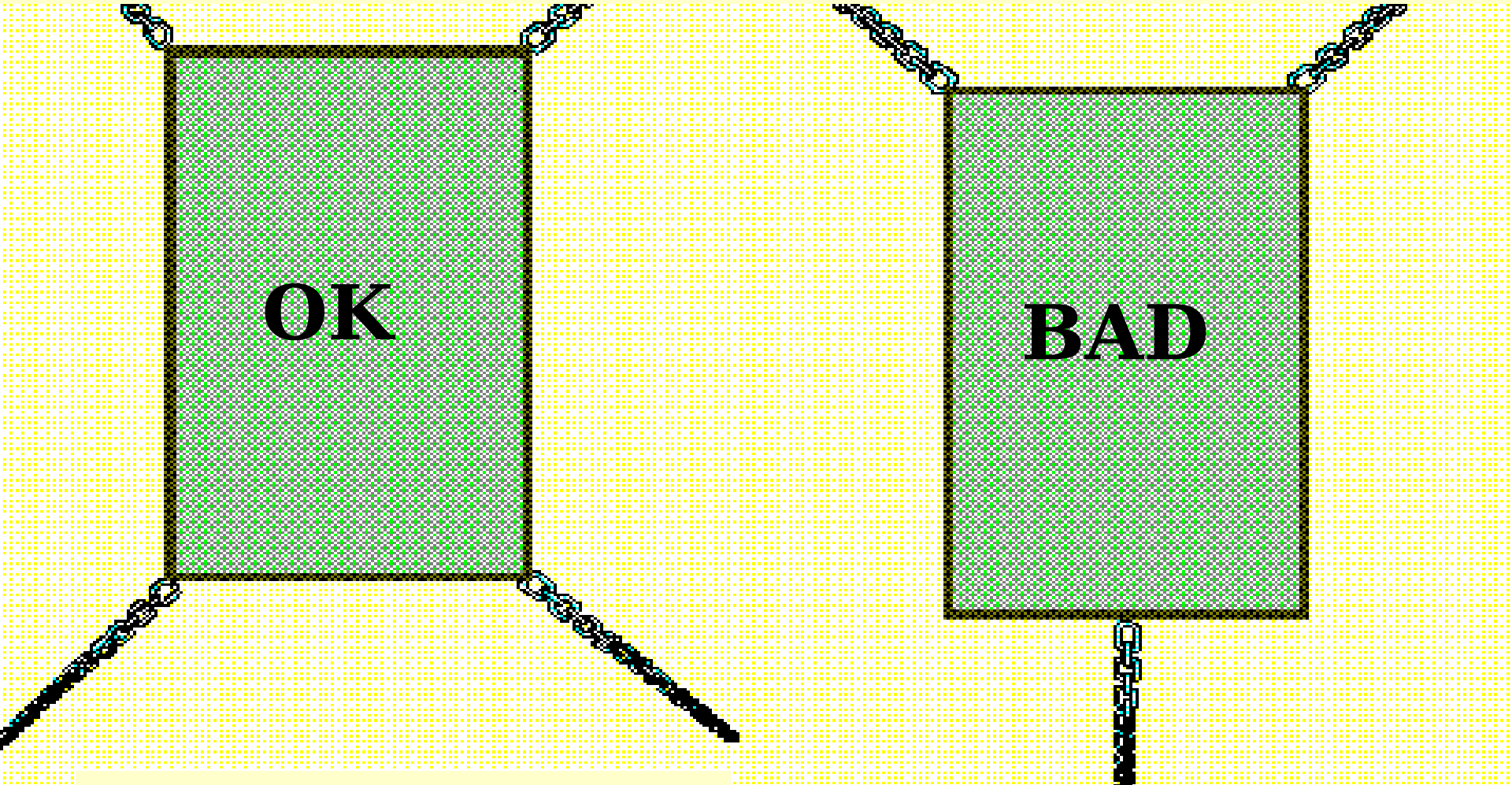
RULES OF APPLICATION

- Attain required directional restraint
- Attach symmetrically and in pairs
- Attach to primary points
- No more than half to axles - one direction
- Don’t cross brake lines or cables

TIE-DOWNS

SYMMETRICAL

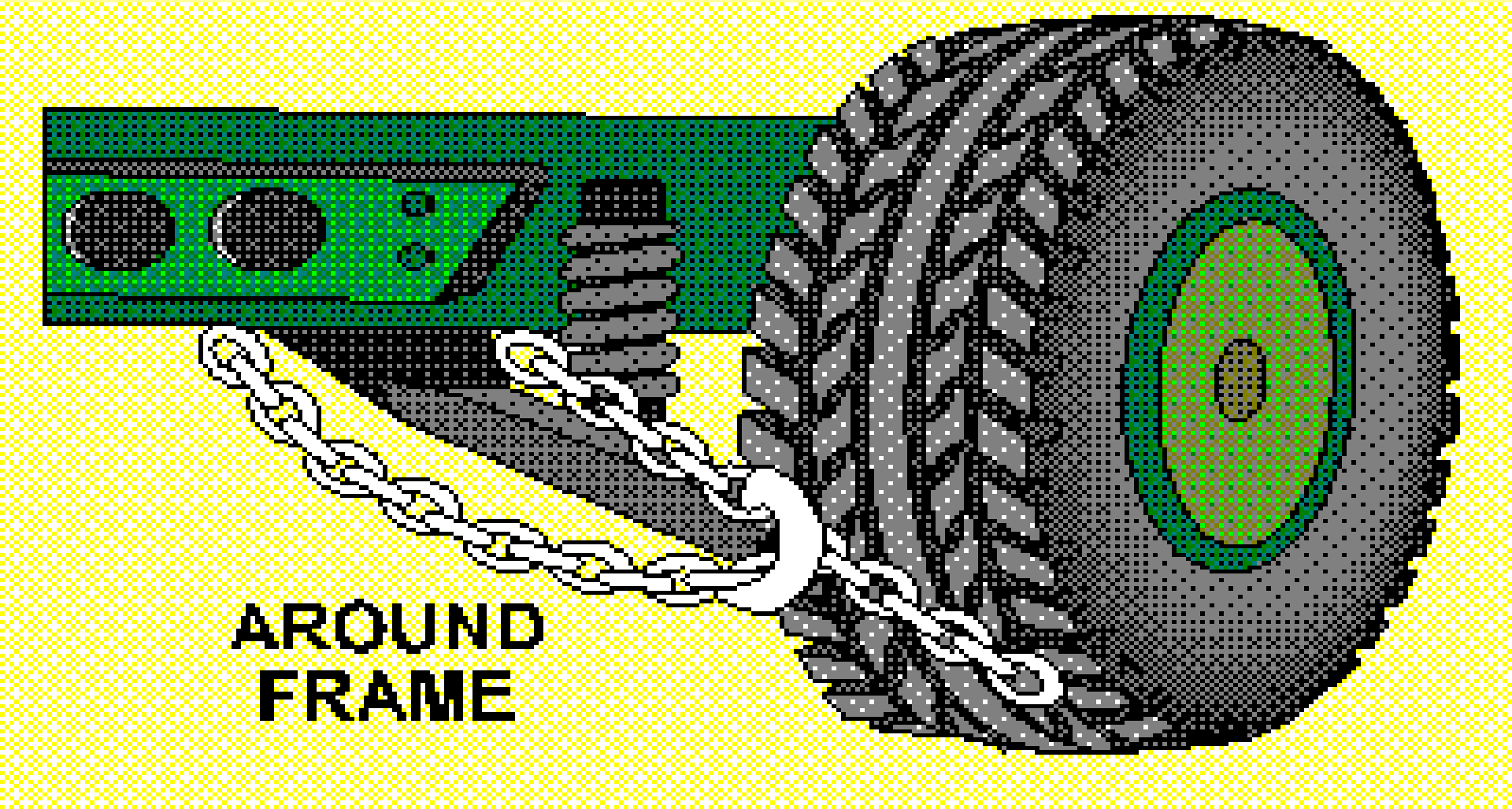
NON-SYMMETRICAL



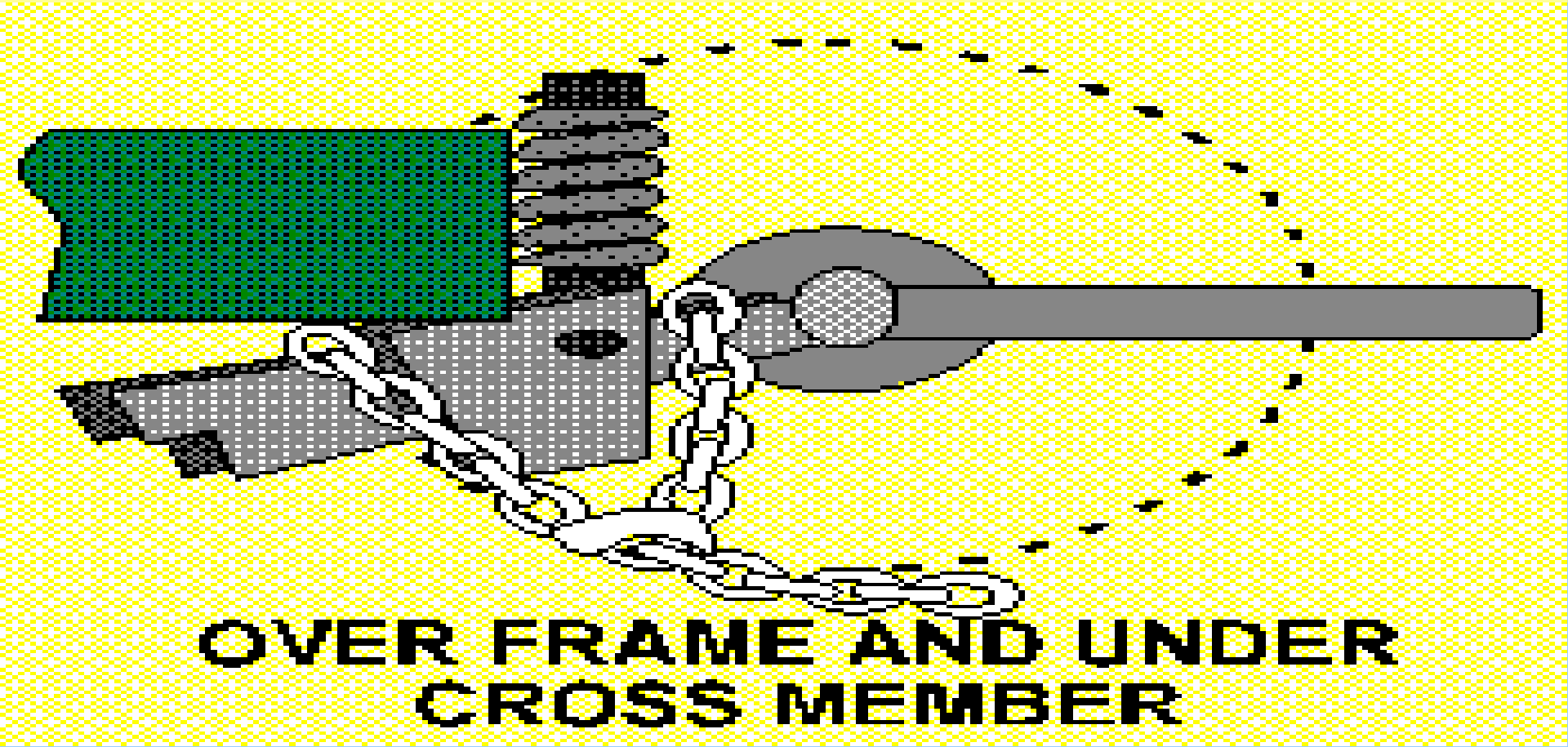
ATTACHMENT POINTS

- **Bumper (Use clevises if installed)**
- **Frame**
- **Axle**

Attach tie-down devices to designed tie-down points such as lifting shackles, if available. If they are not available use strong structural points such as frame members, bumper supports, or axles.

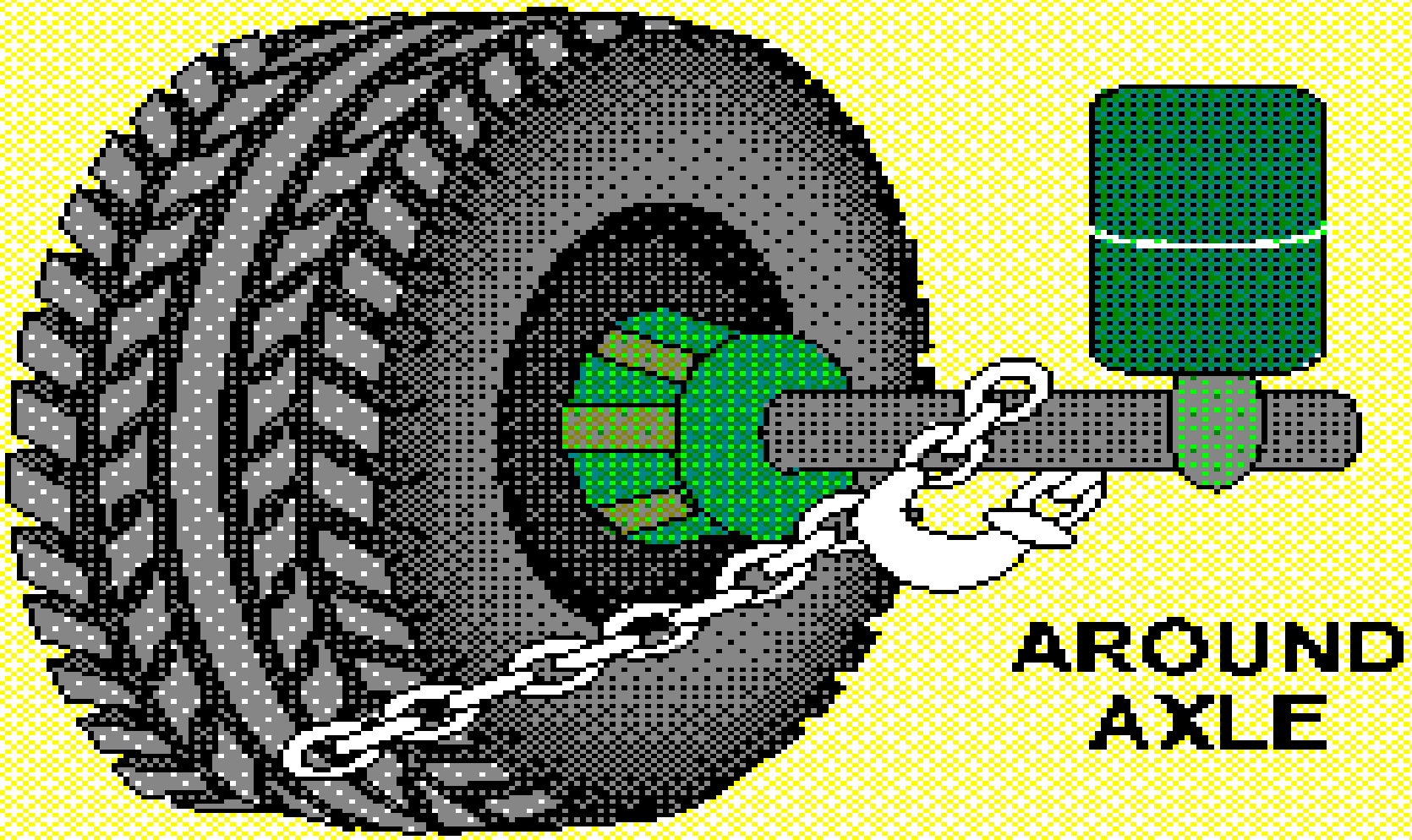


Over the frame and under the cross member is similar to restraining the axle which mainly restrains unsprung weight (axles, tires, etc.) as opposed to restraining the frame which is sprung weight (all weight above the springs and axles).

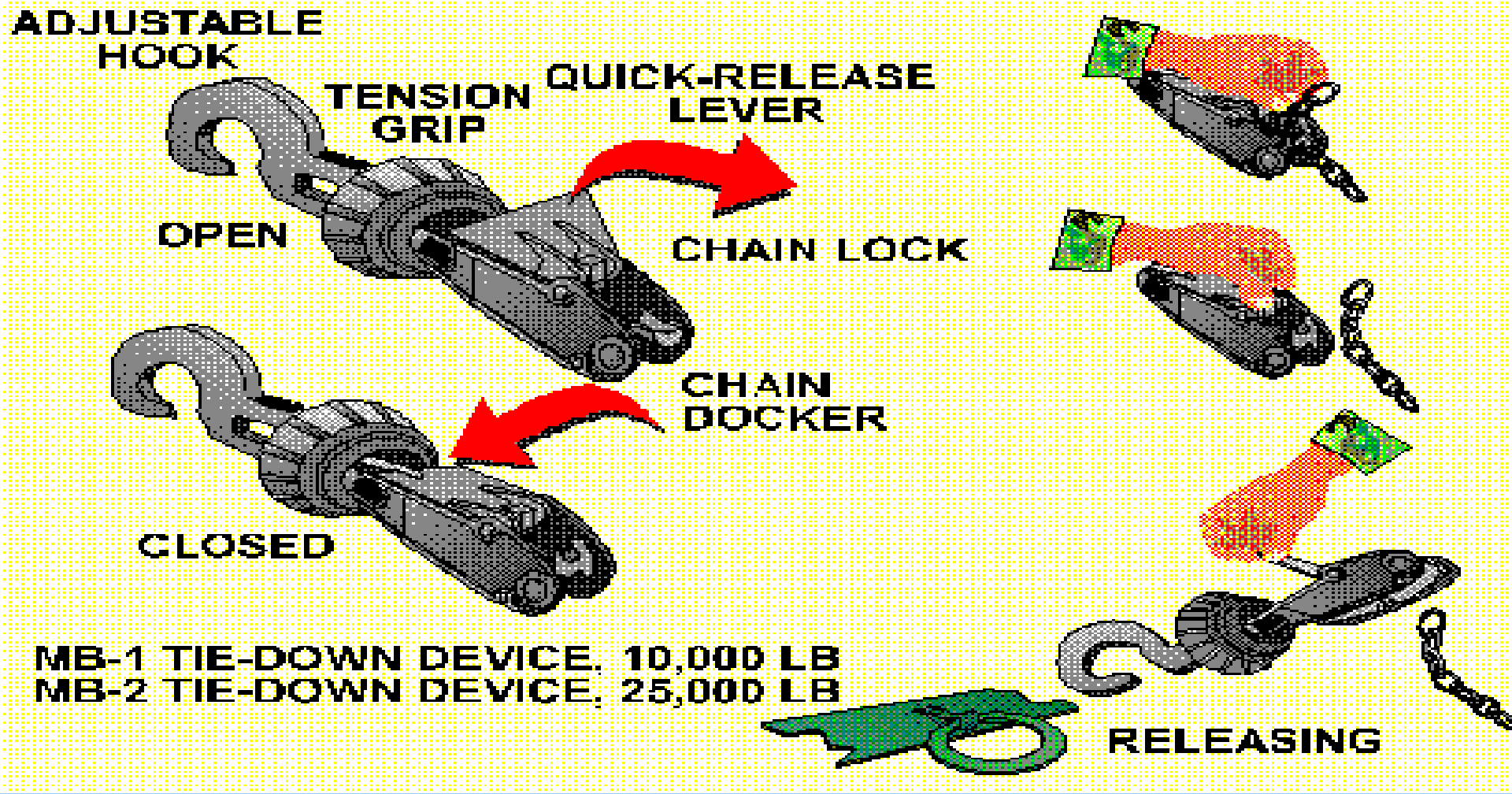


When using the axle as a tie-down point, do not depend on friction or tension to prevent the chain from sliding.

Place the chains against something solid such as brackets or housings. Use no more than 50% of restraint on axles in any given direction, and do not crush air, hydraulic, or fuel lines.



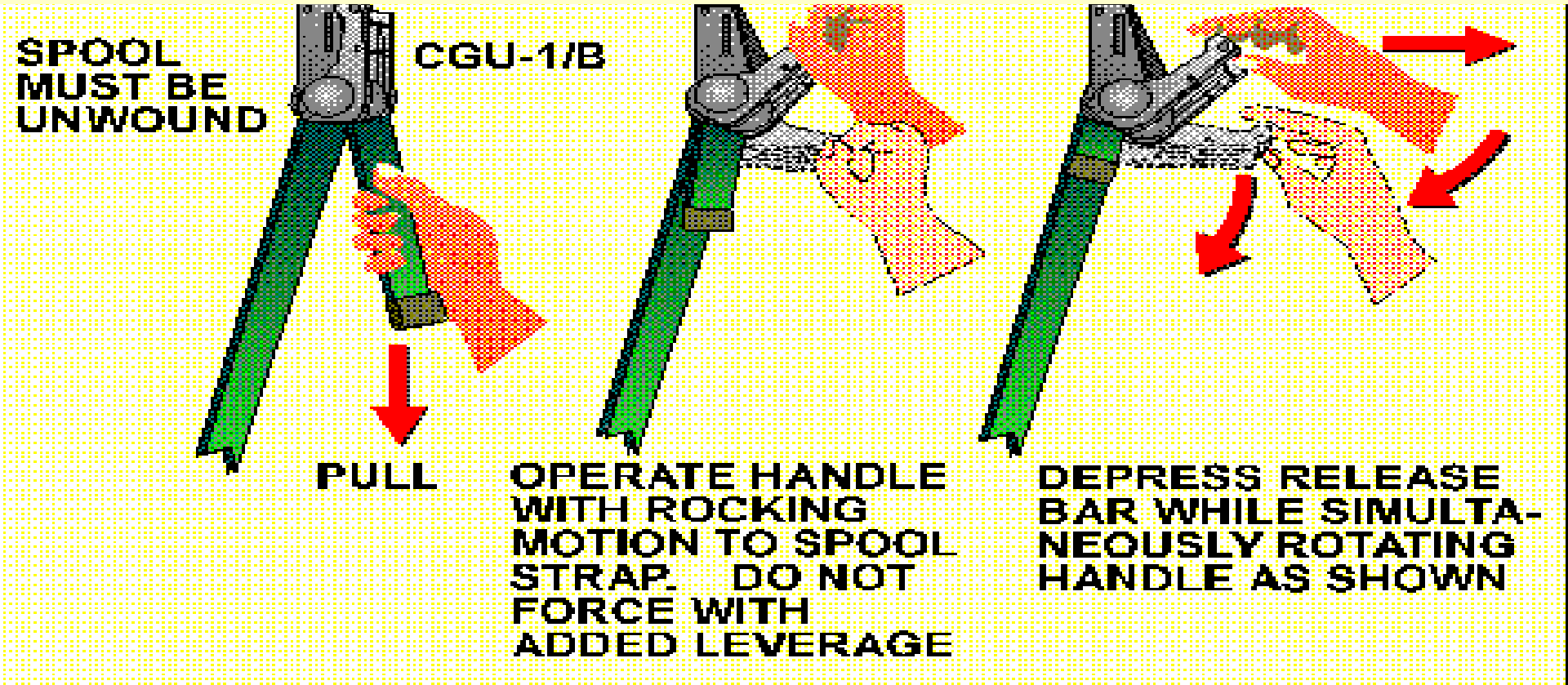
- **Turn the rings in the floor and tie-down fittings so that tension is applied to the top of the ring.**
- **Attach the hook end of tie-down to aircraft floor & chain's hook to cargo.**



CGU-1/B CARGO STRAP

Use protective padding when using the CGU-1/B strap to secure cargo with edges.

Use cargo straps on cargo that may be damaged by chains.



PREFERRED ANGLES OF APPLICATION

- **30 DEGREE PLAN & 30 DEGREE FLOOR ANGLE**

  (30 X 30)

- **45 DEGREE PLAN & 45 DEGREE FLOOR ANGLE**

  (45 X 45)

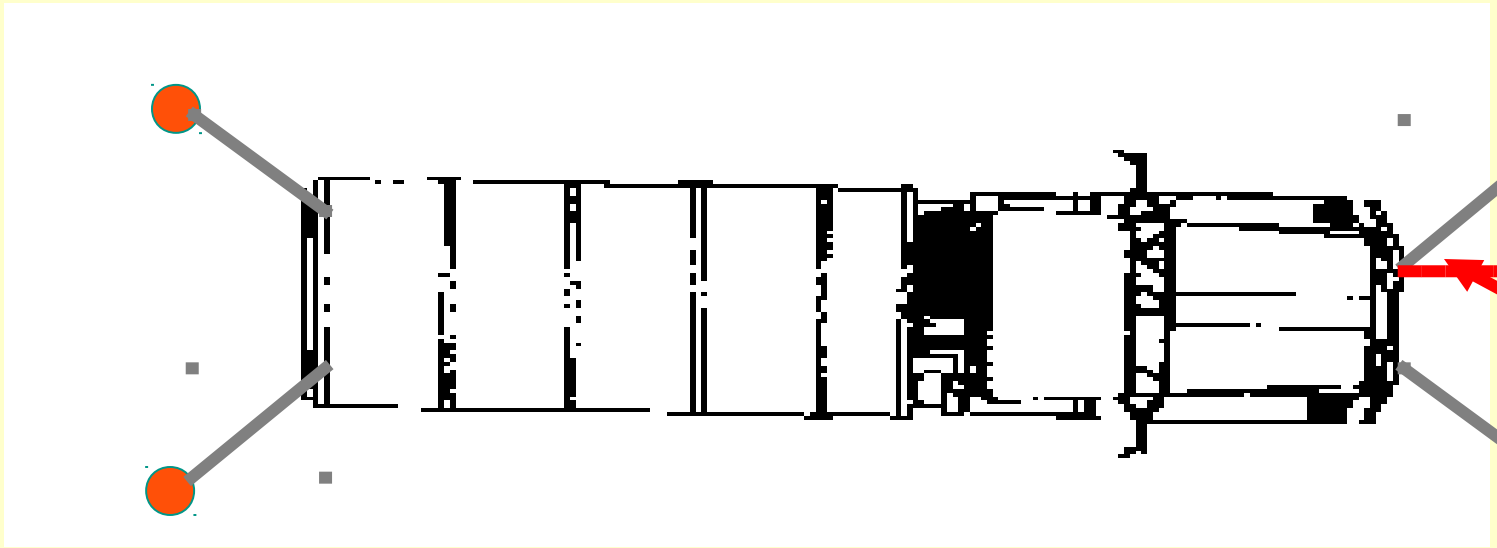
TIE-DOWN PATTERN

Whenever possible, install tie down devices at an angle of 30° from the cargo floor and 30° from the longitudinal axis.

Lead the tie-down directly from floor fitting to the load being controlled.

Tie-down devices and fittings must be equal strength.

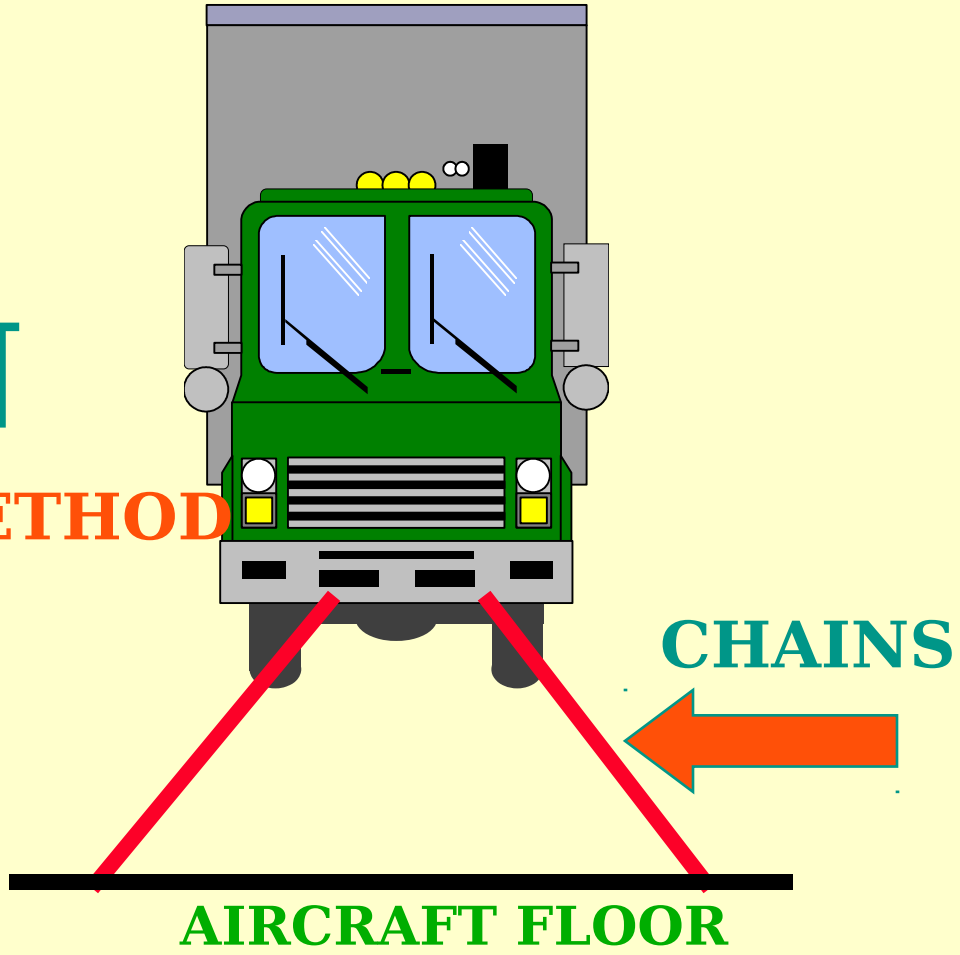
Tighten devices so that equal tension is maintained throughout the arrangement.



METHODS OF APPLICATION

OPEN

PREFERRED METHOD

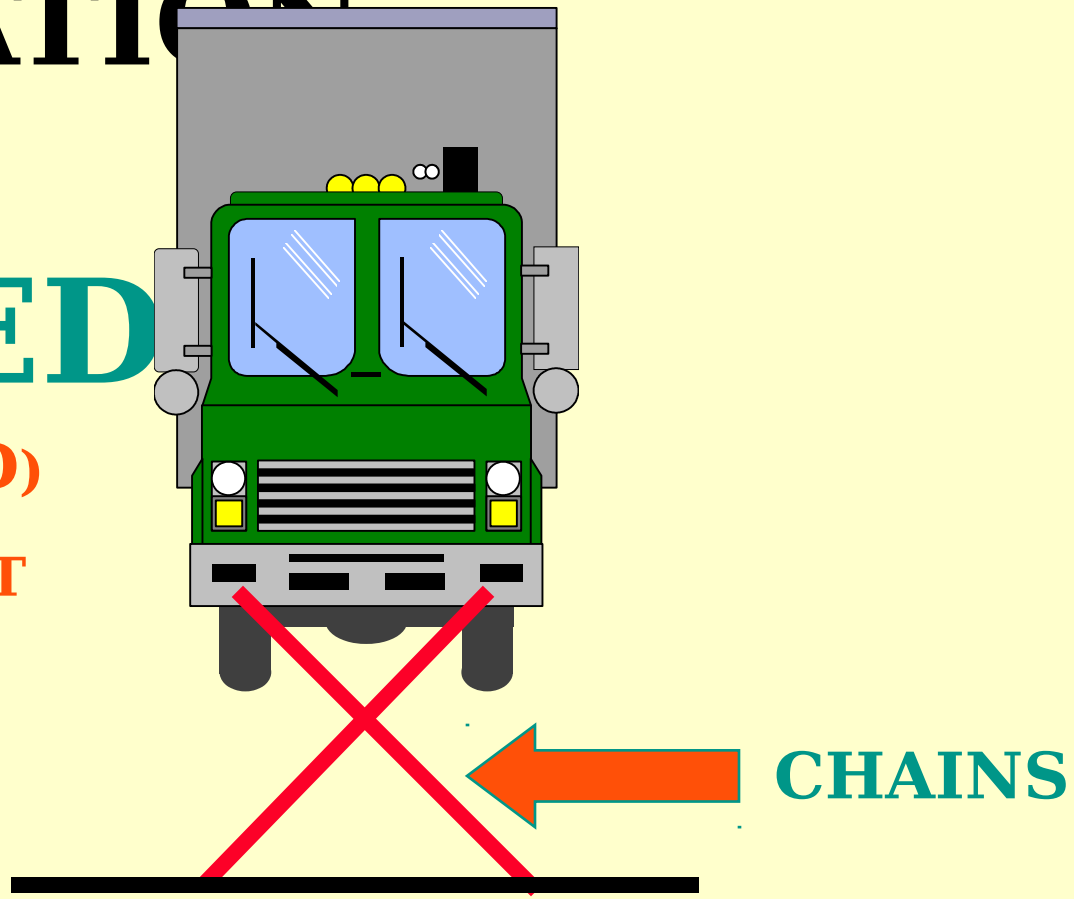


METHODS OF APPLICATION

CLOSED

(CROSSED)

WITH AIRCRAFT LOADMASTER APPROVAL



PERCENT EFFECTIVENESS

- 30º x 30º = 75 %
- 45º x 45º = 50 %

APPROXIMATE RESTRAINT

- 30º x 30º 10,000 lbs. x 75% = 7,500 lbs.
  MB-1
- 45º x 45º 10,000 lbs. x 50% = 5,000 lbs.
  MB-1

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- 30º x 30º 25,000 lbs. x 75% = 18,750 lbs.
  MB-2
- 45º x 45º 25,000 lbs. x 50% = 12,500 lbs.
  MB-2

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- CGU-1/B 5,000 lbs. x 75% = 3,750 lbs.

RESTRAINT FORMULA

RESTRAINT CRITERIA (G) x WEIGHT OF ITEM = # OF TIEDOWNS
APPROXIMATE RESTRAINT OBTAINED REQUIRED

Take the directional restraint in Gs and multiply it by the gross weight of the item of cargo to be restrained. Then divide this number by the approximate amount of restraint coming from the tie-down chains/devices based on the angle applied (30x30 angle or 45x45 angle). The result is the number of chains needed (in even numbers) to secure the cargo for that given direction.

SAMPLE APPLICATION OF FORMULA

(USING MB-1 CHAINS/DEVICES)

$$\frac{\text{3.0 G's FWD x 10,000 lb. item}}{\text{7,500 LBS}} = \text{?}$$

 # chains required

SAMPLE SOLUTION FOR FORMULA

$$\frac{30{,}000}{7{,}500} = 4$$

- **REQUIRES 4 CHAINS**

SAMPLE PROBLEM

SITUATION:

A 20,000 LB. VEHICLE IS TO BE RESTRAINED USING MB-2 CHAINS AND DEVICES AT A 30º x 30º ANGLE.

HOW MANY CHAINS ARE REQUIRED ?

SAMPLE PROBLEM

RESTRAINT CRITERIA		CARGO WEIGHT	REQ'D REST.	APPROX. % OF EFFECTIVENESS 75 %	#OF TIEDOWNS
FWD	3				
AFT	1.5				
LAT	1.5				
VERT	2				

SAMPLE PROBLEM SOLUTION

RESTRAINT CRITERIA		CARGO WEIGHT	REQ'D REST.	APPROX. % OF EFFECTIVENESS 75 %	#OF TIEDOWNS
FWD	3	20,000	60,000	18,750	3.2 =4
AFT	1.5	20,000	30,000	18,750	1.6 =2
LAT	1.5	20,000	30,000	18,750	1.6 =2
VERT	2	20,000	40,000	18,750	2.1 =4

SAMPLE SOLUTION

6 CHAINS REQUIRED - MINIMUM

IN GENERAL, PROPER APPLICATION OF FORWARD AND AFT RESTRAINT WILL SATISFY LATERAL AND VERTICAL RESTRAINT.

CONSULT WITH AIRCRAFT LOADMASTER FOR ANY ADDITIONAL RESTRAINT REQUIREMENTS.

SUMMARY

- CRITERIA
- EQUIPMENT
- APPLICATION
- EFFECTIVENESS
- FORMULA